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BIOLOGY

Aphanizomenon Elenkinii Kissel in Minnesota Lakes

HIBBERT HILL*

ABSTRACT — *Aphanizomenon Elenkinii* Kissel., heretofore described only from the Black Sea area of Russia, has been observed during four summers in lakes near Minneapolis, Minn. A description of the Minnesota alga is given. It has features not noted in previous descriptions.

Aphanizomenon Elenkinii was first described from the Volga River by Kisselev (1951). Variations of it from the same region were later described by Kaschtanova (1955), Pitzyk (1956), and Komarek (1958). The variations here described were first seen by the writer in 1966, in lakes near Minneapolis, Minnesota. It is believed that these are the first observations of *A. Elenkinii* from North America.

The lakes and ponds in which the Minnesota alga has been found are listed in Appendix A. All of them are shallow and eutrophic. Several of the lakes listed have been observed each summer, 1966-69 inclusive. *A. Elenkinii* has never been plentiful in any of these lakes. Further, the amounts found have varied greatly from year to year – from relative abundance to virtual disappearance. In each year of observation *A. Elenkinii* has appeared in the plankton in late July, reached a maximum in September, and disappeared in late October.

The Minnesota alga is quite variable in form and habits. Three principal forms have been distinguished, hereafter designated Types I, II, and III. The dimensions of these types are given in Table 1, and the types are illustrated in Figures 1 and 2. The three types may be found together, but, so far, always with Types I or II dominant. Type III has never been found in quantity. None of the three types forms bundles as does *A. flos aquae.*

Type I is distinguished as a long trichome which may contain multiple heterocysts and multiple akinetes. The heterocysts appear before the akinetes do and at this stage are quite uniformly spaced in the trichome, Fig. 1, n. As many as 9 heterocysts have been seen in one trichome. The akinetes, when they appear, may have any position in the trichome, and may be single and spaced, or in sets of 2 to 5. As many as 12 akinetes have been seen in a trichome.

Heterocysts may be, usually are, present in trichomes having akinetes. However, though this alga was fairly abundant in Lotus Lake during September, 1969, only one heterocyst was seen. It has been noted that in this lake heterocysts are rarely seen in *Aphanizomenon flos aquae* during the akinete bearing season, and this was the case in 1969, as with *A. Elenkinii.*

The characteristic terminal structure of the Minnesota alga is narrow, tapers smoothly or in steps, and has hyaline, or nearly so, terminal cells, Figs. 1 and 2. The apical cells are not as fine and sharp pointed as those described by Kisselev and Pitzyk. It is believed that terminals such as b, e, d, Fig. 1, result when the apical cells break off.

The characteristic Type II trichome, aa and bb, Fig. 1, is relatively short, does not have the elongated terminal cells of Type I, and has one or two akinetes close to – typically 2 cells away from – a heterocyst which is approximately central in the trichome. A second developing (or abortive?) heterocyst is often found near one terminal. One or two terminal cells are decreased in diameter. These cells usually are well pseudovacuolated, but may be partially hyaline. The tip of the apical cell often is hyaline. When there are two akinetes they are usually not equally mature.

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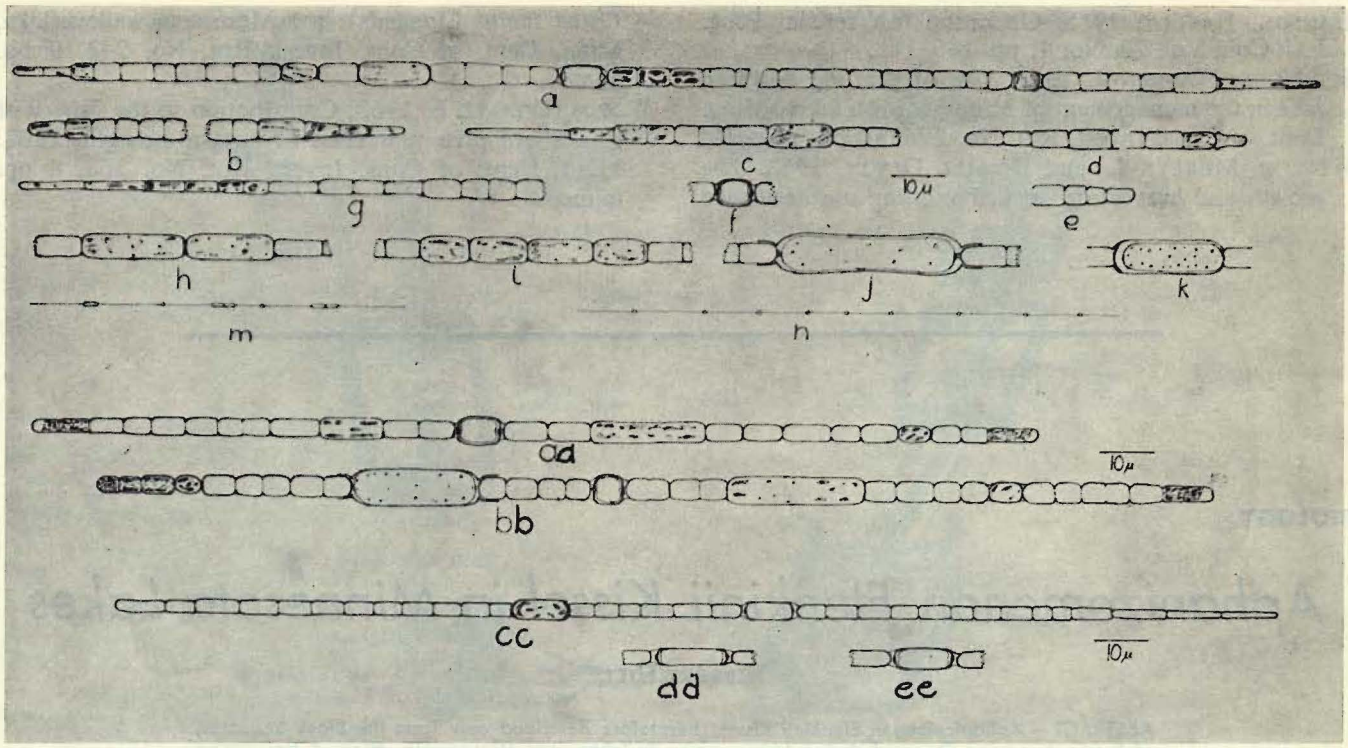

FIGURE 1

Type I, a-n. a. Trichome with developing akinete. "Rod" shape of gas vacuoles indicated near heterocyst. a.b.c.d.e.g. Illustrate common terminal shapes. f. Heterocyst. h.i. Immature akinetes. j. Mature constricted akinete. k. Detached mature akinete. m. Schematic of trichome with 5 akinetes and 2 heterocysts. n. Schematic of trichome with 9 heterocysts.

Type II, aa.-bb. aa. Trichome with immature akinetes. Note hyaline apex of some terminal cells, a frequent feature. bb. Trichome with one mature and one immature akinete.

Type III, cc-ee. cc Trichome with immature akinete. dd, ee. heterocysts. Note proportions of dd.

The Type III trichome is narrow and has elongated, hyaline, terminal cells which decrease diameter in steps. It contains one heterocyst and one or two akinetes. The akinetes observed have all been small. The heterocysts are often strikingly elongated, e.g., Fig. 1, dd.

The cells of all three types contain gas vacuoles which appear massive and "rod" shaped, as indicated in the cells near the heterocyst of Fig. 1, a.

The akinetes of all three types are a translucent dark green color when immature, and then contain prominent elongated gas vacuoles. The mature akinetes are paler in color, may have a yellowish cast, and are uniformly granulated. The akinetes of Types I and II are sometimes centrally narrowed, Fig. 1, j, and Fig. 2.

Mature akinetes have a separated outer wall to which are attached terminal cups which hold the adjacent cells, Fig. 1, j, k, and Fig. 2. Detached akinetes having these features are often found in the plankton, and have been recovered from sediment samples. The writer believes the terminal cups to be unique to the Minnesota alga. They have not been noted in any previous description. They are not found in *A. flos aquae*.

TABLE 1 – APHANIZOMENON ELENKINII Kissel.

	Type I	Type II	Type III	Kisselev, 1951
Trichome length, u.	to 1120	to 456	to 372	to 520
Cell width, u.	3.0-4.0-(4.5)	(2.5)-3.0-4.0	2.5-2.8	3.0-4.0
Cell length, u.	4.0-10 -(12.0)	4.0-10	4.0-9.0-(13)	5.5-12
Heterocyst width, u.	(3.5)-4.0-5.0-(6.5)	(3.2)-3.5-4.5	(2.5)-3 -3.5	2.5-4.0
Heterocyst length, u.	(6.0)-6.5-9.0-(12.0)	(5.3)-6.0-10	(6.0)-7.0-11-(15)	7.0-14
Akinete width, u.	(4.0)-4.5-7.2	(4.0)-4.5-6.0-(7.0)	3.6-4.6	4.5-5.5
Akinete length, u.	(11)-17 -35	(17)-20 -37	11 -17.5	11 -19
No. heterocysts	1-12	1-3	1-2	?
No. akinetes	1-9	1-3	1-2	1, rarely 2-3

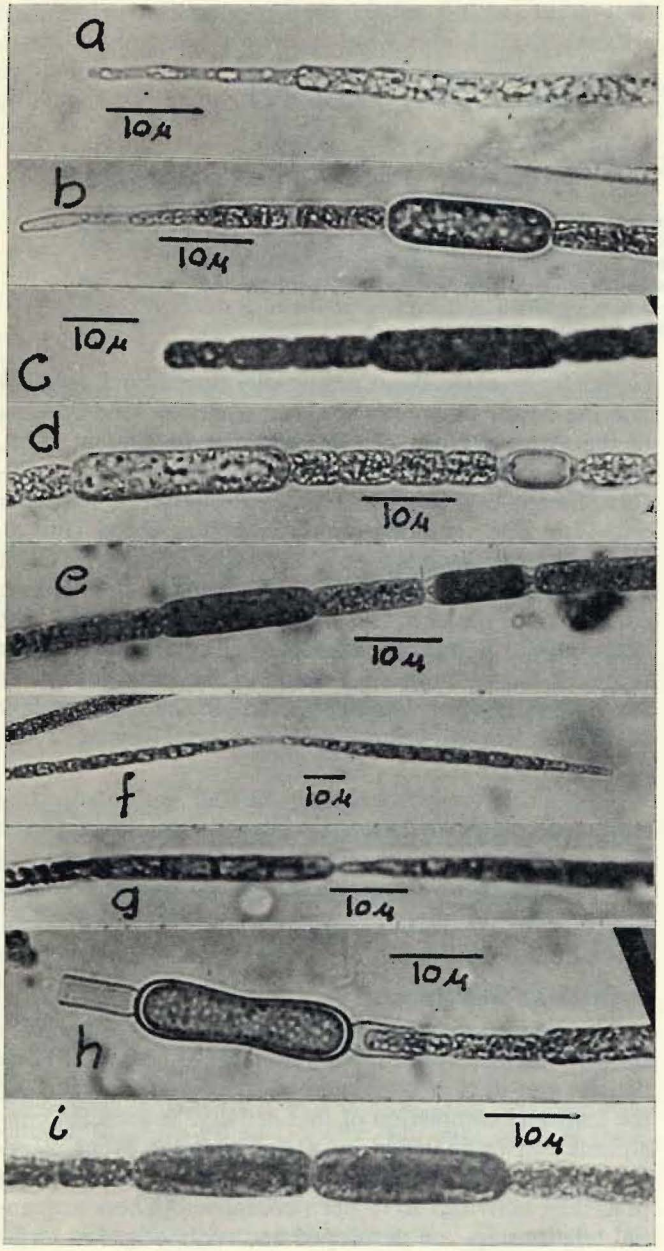

FIGURE 2. a. Terminal, Type I. b. Immature akinete and terminal, Type I. c. Terminal, Type II. d. and e. Akinetes and heterocysts, Type II. Heterocyst of e. is stained with gentian violet. f., g. Nearly complete separations in trichomes. h. Mature constricted akinete and second immature akinete. Separation from trichome nearly complete. Cups are unusually long. i. Akinete pair.

Deep constrictions at septa, as though the trichome were pinching apart, are commonly observed in long trichomes of Type I. On two occasions trichomes have been observed which had long constrictions involving several cells, Fig. 2, f, g, and having the appearance of two normal termini tip to tip. Apparently new trichomes are formed by breakage of old, long, ones, and the characteristic terminal cells may form on both sides of the break before separation occurs.

The Minnesota *A. Elenkinii* agrees generally with previous descriptions. It differs, however, in the terminal shape, in the greater length of its trichomes, in its great number of heterocysts and akinetes, in the symmetrical/akinete arrangement and terminal cells of Type II, and in the terminal cups of its akinetes.

Appendix A.

Aphanizomenon Elenkinii has been collected by the writer from the following Minnesota Lakes:

Starring Lake, Hennepin County
Galpin Lake, Hennepin County
Lake of the Isles, Hennepin County, in Minneapolis.
Pond 1, Hennepin County, in Excelsior.
Tanager Lake, Hennepin County
Lotus Lake, Carver County, Minn.
Pond left by the receding Minnesota River, near Chaska.

In addition, this alga was seen in a sample collected by others from Lac Qui Parle, Minn., and has been observed also by Mrs. Kathi Baker in samples from shallow bays of Lake Minnetonka.

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